

Inpatient capsule endoscopy leads to frequent incomplete small bowel examinations

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Abstract

AIM: To examine the predictive factors of capsule endoscopy (CE) completion rate (CECR) including the effect of inpatient and outpatient status.

METHODS: We identified 355 consecutive patients who completed CE at Rush University Medical Center between March 2003 and October 2005. Subjects for CE had either nothing by mouth or clear liquids for the afternoon and evening of the day before the procedure. CE exams were reviewed by two physicians who were unaware of the study hypotheses. After retrospective analysis, 21 cases were excluded due to capsule malfunction, prior gastric surgery, endoscopic capsule placement or insufficient data. Of the remaining 334 exams [264 out-patient (OP), 70 in-patient (IP)], CE indications, findings, location of the patients [IP *vs* OP and intensive care unit (ICU) *vs* general medical floor (GMF)] and gastrointestinal transit times were analyzed. Statistical analysis was completed using SPSS version 17 (Chicago, IL). Chi-square, *t* test or fisher exact-tests were used as appropriate. Multivariate logistic regression analysis was used to identify variables associated with incomplete CE exams.

RESULTS: The mean age for the entire study population was 54.7 years. Sixty-one percent of the study population was female, and gender was not different between IPs *vs* OPs ($P = 0.07$). The overall incomplete CECR was 14% in our study. Overt obscure gastrointestinal bleeding (OGB) was a significantly more common indication for the IP CE ($P = 0.0001$), while abdominal pain and assessment of IBD were more frequent indications for the OP CE exams ($P = 0.002$ and $P = 0.01$, respectively). Occult OGB was the most common indication and arteriovenous malformations were the most common finding both in the IPs and OPs. The capsule did not enter the small bowel (SB) in 6/70 IPs and 8/264 OPs ($P = 0.04$). The capsule never reached the cecum in 31.4% (22/70) of IP *vs* 9.5% (25/264) of OP examinations ($P < 0.001$). The mean gastric transit time (GTT) was delayed in IPs compared to OPs, 98.5 ± 139.5 min *vs* 60.4 ± 92.6 min ($P = 0.008$). Minimal SB transit time was significantly prolonged in the IP compared to the OP setting [IP = $275.1 \pm$

111.6 min *vs* OP = 244.0 ± 104.3 min ($P = 0.037$)). CECR was also significantly higher in the subgroup of patients with OGB who had OP *vs* IP exams (95% *vs* 80% respectively, $P = 0.001$). The proportion of patients with incomplete exams was higher in the ICU ($n = 7/13$, 54%) as compared to the GMF ($n = 15/57$, 26%) ($P = 0.05$). There was only a single permanent SB retention case which was secondary to a previously unknown SB stricture, and the remaining incomplete SB exams were due to slow transit. Medications which affect gastrointestinal system motility were tested both individually and also in aggregate in univariate analysis in hospitalized patients (ICU and GMF) and were not predictive of incomplete capsule passage ($P > 0.05$). Patient location (IP *vs* OP) and GTT were independent predictors of incomplete CE exams ($P < 0.001$ and $P = 0.008$, respectively).

CONCLUSION: Incomplete CE is a multifactorial problem. Patient location and related factors such as severity of illness and sedentary status may contribute to incomplete exams.

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Key words: Capsule endoscopy; Completion rate; Inpatient; Outpatient; Hospitalization

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INTRODUCTION

In recent years, capsule endoscopy (CE) has emerged as a sophisticated and widely used tool to evaluate small bowel pathology. It has applications in Crohn's disease, celiac disease, Peutz-Jeghers syndrome, familial adenomatous polyposis, and hereditary polyposis syndromes^[1-4]. CE is also particularly useful for the investigation of obscure gastrointestinal bleeding (OGB)^[5,6], especially if upper and lower endoscopies fail to reveal the underlying pathology and a small bowel source is suspected. Locating the source and treating OGB has long been a challenge for physicians. Identification of the bleeding site is the key step not only to diagnose but also to provide effective treatment. During a brisk overt

hemorrhage, the rapidity at which the bleeding site is found is critical. CE is therefore utilized often in patients hospitalized for bleeding and anemia. The hospital setting, however, may not be ideal in obtaining optimal results with CE. In-patients tend to be sedentary and are more prone to delayed transit or ileus, which may prolong gastric and small bowel transit times. Therefore, we hypothesized that in-patient (IP) CE is more often incomplete as compared to out-patient (OP) CE. The two previously published European studies indirectly examining this question have compared IP *vs* OP CE completion rates (CECR)^[7,8], but both studies have limitations: both used a prokinetic agent and/or bowel preparation to increase CECR and neither of these interventions is part of the standard CE protocol at United States institutions. Furthermore, the patient numbers were small and the studies did not examine the effects of inpatient location (i.e., an intensive care unit (ICU) *vs* a general medical floor (GMF) setting). In this study, we aimed at overcoming these limitations by analyzing all consecutive IPs and OPs, studying a larger IP group, doing a subgroup analysis to compare the ICU and GMF settings, without the use of prokinetic and bowel preparation agents.

MATERIALS AND METHODS

This study was conducted in compliance with ethical guidelines and was approved by Rush University Institutional Review Board. All CE examinations done at Rush University Medical Center between March, 2003 and October, 2005 were identified retrospectively. A total of 355 CE exams, which were performed using a Given PillCamTM small bowel (SB) capsule, were reviewed using the Given Rapid[®] Access software. Patients with capsule malfunction ($n = 6$), prior gastric surgery ($n = 3$), endoscopic capsule placement ($n = 3$) and studies lacking sufficient data for analysis were excluded ($n = 9$; 8 OP, 1 IP). In the remaining 334 exams (264 OP, 70 IP), patient characteristics such as age, gender, gastric retention of the capsule, completeness of the examination (whether or not the capsule reached the cecum), gastric and small bowel transit times, indications and findings were recorded.

Subjects for capsule endoscopy had either nothing by mouth (except their medications) or clear liquids (excluding any red colored foods) for the afternoon and evening of the day before the procedure. The CE exam was delayed if subjects used iron supplementation within the past 5 d prior to the procedure.

CE exams were reviewed by two physicians. For the majority of cases, gastroenterologists who read the CE exams did not have any information regarding patient location. The hypotheses of the study were conceived after the exams were read and gastroenterologists were unaware of the study hypotheses.

Overt gastrointestinal bleed (GIB) was defined as having melena and/or hematochezia with a hemoglobin < 10 g/dL. Occult obscure GIB was defined as subjects

Table 1 Baseline characteristics of study population, capsule endoscopy indications and findings *n* (%)

Patient characteristics	IP (<i>n</i> = 70)	OP (<i>n</i> = 264)	<i>P</i> value
Age (yr)	60.9 ± 18.4	53.0 ± 17.7	0.001 ¹
Gender (male/female)	34/36	96/168	0.07
Indications			
Occult obscure GIB	37 (52.9)	124 (46.9)	0.381
Overt GIB	24 (34.3)	23 (8.7)	0.0001
Abdominal pain	11 (15.7)	92 (36.7)	0.002
Assess IBD	8 (11.4)	83 (31.4)	0.001
Assess small bowel masses	1 (1.4)	17 (6.4)	0.137
Assess celiac disease	1 (1.4)	3 (1.1)	1.000
Others	0 (0)	9 (3.4)	0.213
Findings			
AVM	33 (47.1)	116 (43.9)	0.632
SB ulceration/erosion	19 (27.1)	116 (43.9)	0.011
Active bleed	11 (15.7)	12 (4.6)	0.001
Esophagitis/duodenitis/gastritis	7 (10.0)	28 (10.6)	1.000
Mass/polyp	13 (18.6)	43 (16.3)	0.649
Excess retained food	7 (10.0)	22 (8.3)	0.660
Others	6 (8.6)	19 (7.2)	0.698

IP: In-patient; OP: Out-patient; GIB: Gastrointestinal bleed; IBD: Inflammatory bowel disease; AVM: Arteriovenous malformation; SB: Small bowel. ¹*t* test; the rest, Chi-square or fisher exact test as appropriate.

who had a positive fecal occult blood test or complaints of intermittent black bowel movements, and who had both colonoscopy and upper endoscopy without any source of bleeding identified. Accurate SB transit time (SBTT) were obviously not available in those subjects in whom the capsule stopped recording before reaching the colon. In this circumstance the minimum SBTT, which reflects the minimum time the capsule spent in the small bowel, was calculated using the formula, 480 min - the gastric transit time (GTT) (min) = minimum SBTT. Four hundred and eighty minutes was used as this has the generally accepted battery life of the Given PillCam™ SB capsule at the time of the CE exams.

Statistical analysis was completed using SPSS version 17 (Chicago, IL). Chi-square, *t* test or fisher exact-test was used as appropriate. Multivariate logistic regression analysis was used to identify variables associated with incomplete CE exams. A multivariate logistic regression model was constructed using forward stepwise method with capsule reaching the cecum or not as the dependent variable using the univariate variables that were significantly predictive of incomplete capsule passage. In addition, differences in bowel transit time between the groups were compared by a survival model (Kaplan-Meier) and (Log-Rank test).

RESULTS

Study population

The baseline characteristics of the IPs *vs* OPs that underwent CE are shown in Table 1. The mean age for the entire study population was 54.7 (17-92) years. The mean age for the IPs was greater than the OPs (60.9 ± 18.4 *vs* 53 ± 17.7, *P* = 0.001). Sixty-one percents of the

study population was female, and gender was not different between IPs *vs* OPs (*P* = 0.07). The indications for CE were occult OGB, overt OGB, abdominal pain, and assessment for inflammatory bowel disease (IBD), SB masses, celiac disease and other pathologies. Several patients had more than one indication for the CE examination. Occult OGB was the most common indication for both the IPs and OPs. While evaluation of overt OGB was significantly more common for the IP CE (*P* = 0.0001), abdominal pain and assessment of IBD were more frequently the indications for the OP CE exams (*P* = 0.002 and *P* = 0.01, respectively). Arteriovenous malformations (AVM) were the most common finding both in the IPs and OPs. Active bleeding was seen more often in the IPs (*P* = 0.001); while SB ulcerations and erosions were more frequently observed in the OP CE exams (*P* = 0.011).

Completion rates of CE

The overall incomplete CECR was 14% in our study. A higher number of patients in the OP group had complete CE with visualization of the entire SB, compared to the IP group (90.5% *vs* 68.6%, *P* < 0.001). The capsule remained within the stomach for the duration of the study in 8.6% (6/70) of the IPs and 3% (8/264) of the OPs (*P* = 0.04). When these cases of gastric capsule retention were excluded, 25% (16/64) of the IPs and 6.6% (17/256) of the OPs had exams that were not complete, as the capsule did not reach the cecum (*P* = 0.001). Therefore, both gastric capsule retention with reduced entry into the SB as well as delayed transit in the SB played a role in the incomplete CE exams in the IPs. Obstructing lesions in the SB were uncommon. There was only a single permanent small bowel retention case in the dataset, who was an OP with a previously unrecognized stricture. The remainder of the incomplete SB exams appeared to be due purely to slow transit. To exclude a diagnosis related bias in the analysis, we also looked at the OGB subset of our data. CECR was also significantly higher in OGB patients who had OP *vs* IP exams (95% *vs* 80% respectively, *P* = 0.001). Therefore, the result obtained can not be solely explained by differences in the OP *vs* IP diagnoses.

Transit times in the stomach and small bowel

A Kaplan-Meier plot of total bowel transit time for the IPs *vs* the OPs is shown in Figure 1. As time passes more studies get completed in the OP group compared to the IP group. The median total capsule transit time to the cecum was longer in IP *vs* OP (368 min *vs* 279 min) (*P* < 0.0001, log-rank for median total capsule transit time).

In 10 patients (3 IPs and 7 OPs), GTT were not recorded into the CE report. In the remaining 324 patients, the mean GTT was prolonged in the IP setting. GTT was 98.5 ± 139.5 min in IP *vs* 60.4 ± 92.6 min in OP setting (*P* = 0.008). After removing those patients with gastric capsule retention and lack of GTT measurements from the dataset, minimum SBTT were signifi-

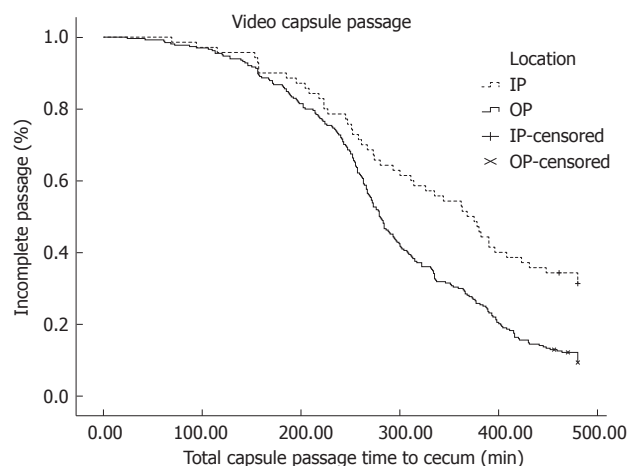


Figure 1 Kaplan-Meier plot of total capsule passage time to cecum. Incomplete passage percentage and total capsule passage time to cecum were different between inpatients (IP) and outpatients (OP). Data is shown for the IP group (dotted line) vs the OP group (solid line). X-axis represents bowel passage time and Y-axis represents the percentage of patients in whom the capsule has not reached the cecum.

cantly prolonged in the IP setting (275.1 ± 111.6 min) *vs* the OP setting (244.0 ± 104.3 min) ($P = 0.037$).

Effect of inpatient location

Among the 70 IPs studied, 13 were in the ICU and 57 were on a GMF. There was no statistical difference in mean age and gender in the ICU *vs* GMF groups, although the ICU patients were relatively older (68.8 ± 13.6 years *vs* 59.1 ± 19.0 years, $P = 0.084$).

The proportion of patients with incomplete exams was higher in the ICU ($n = 7/13$, 54%) as compared to the GMF ($n = 15/57$, 26%) ($P = 0.05$). Gastric capsule retention also was more common among ICU patients compared to the GMF [$2/13$ (15.3%) *vs* $4/57$ (7%), $P = 0.331$]. When subjects with gastric retention were excluded, the proportion of subjects with incomplete small bowel exams were numerically higher $5/11$ (45%) in the ICU setting *vs* $11/53$ (32%) in the GMF setting, but the difference was not statistically significant ($P = 0.085$). The GTTs were not significantly different between the ICU and GMF patients (154.4 ± 181.4 min *vs* 85.0 ± 125.8 min, $P = 0.108$) although a trend toward longer GTT in ICU patients was noted. Minimum SBTT were also not significantly different between the ICU (272.1 ± 131.4 min) and GMF patients (275.8 ± 108.4 min) ($P = 0.922$).

Risk factors for an incomplete exam

We looked at the effects of potential risk factors for an incomplete exam in univariate analyses in all subjects (Table 2). Among pre-procedure risk factors, location (IP *vs* OP setting) and having an indication for gastrointestinal (GI) bleed (either occult or overt) were predictive of incomplete capsule passage. Among post-procedure risk factors, the following findings were predictive of having an incomplete exam: having an AVM, blood, visible vessel, lymphoid hyperplasia, gastric vascular ec-

Table 2 Identification of potential risk factors for an incomplete exam by univariate analysis in all patients

Pre-procedure factors	P value	Post-procedure factors	P value
Location	0.0001	AVM	0.001
Occult GIB	0.042	Blood	0.016
Overt GIB	0.054	Visible vessel	0.013
Abdominal pain	0.608	Lymphoid hyperplasia	0.014
Assessment of IBD	0.142	GAVE	0.051
History of FAP	0.999	Findings suggestive of CD	0.007
History of DA	0.199	Excess food	0.006
Nausea/vomiting	0.879	Phlebectasia	0.011
Diarrhea	0.929	Large gastric folds	0.010
Colon polyps	0.999	White villi	0.01
History of OVR	1	Edema	0.415
History of carcinoid tumors	0.999	Submucosal mass	0.372
History of PJS	1	Mucosal mass	0.119
History of VE	1	Erosions	0.350
Age	0.113	Ulcer	0.308
Gender	0.232	Duodenitis	0.597
		Diverticulitis	0.461
		Mucosal break	0.078
		Esophagitis	0.062
		Stricture	0.399
		Reader	0.982
		GTT	0.0001
		SBTT	0.001

GIB: Gastrointestinal bleed; IBD: Inflammatory bowel disease; FAP: Familial adenomatous polyposis; DA: Duodenal adenoma; OVR: Osler Veber Rendu; PJS: Peutz Jeghers syndrome; VE: Vascular ectasia; AVM: Arteriovenous malformation; GAVE: Gastric vascular ectasia; CD: Crohn's disease; GTT: Gastric transit time; SBTT: Small bowel transit time.

Table 3 Effect of medication use and comorbidities on capsule endoscopy completion rate in hospitalized patients

Risk factors	P values
Diabetes	0.416
Neuropathy	0.382
Hypotension	0.947
Immobility	0.381
Medications in aggregate	0.271
Narcotics	0.311
Anticholinergics	0.815
Beta-blockers	0.711
Calcium channel blockers	0.931
Inotropes	0.197
Motility enhancers	0.337

tesia, findings suggesting Crohn's disease (CD), excess food particles in the GI tract, phlebectasia, having large gastric folds, white appearing villi, GTT, and SBTT. We could not evaluate the effect of medication use in the entire dataset due to lack of accurate medication data in outpatients.

Medications which affect GI system motility were tested both individually and also in aggregate in univariate analysis in hospitalized patients (Table 3). These medications included narcotics, anticholinergics, beta-blockers, calcium channel blockers, inotropic agents, and motility enhancers. None of the medications individually or in aggregate were predictive of "capsule passage" or

Table 4 Independent predictors of incomplete capsule endoscopy in multivariate analysis

Factors	Beta value	SE	Wald $\times 2$	P value	Odds ratio	95% CI
Intercept	-3.369	0.349	93.344	0.000		
Location	1.457	0.415	12.328	0.000	4.294	1.904-9.686
GTT	0.012	0.003	18.177	0.000	1.012	1.006-1.017

GTT: Gastric transit time.

“incomplete capsule exam” ($P > 0.05$, Table 3). Other factors such as diabetes, neuropathy, hypotension, and immobility were not predictive of “capsule passage” or “incomplete capsule exam” either ($P > 0.05$, Table 3).

In the multivariate logistic regression model that utilized all patients, except those who did not have gastric transit times recorded, patient location (IP *vs* OP) and GTT were independent predictors of incomplete CE exams ($P < 0.001$ and $P = 0.008$, respectively). Further details of the model are given in Table 4.

DISCUSSION

Our study represents a first look at the CECR in IPs in the United States, and demonstrates that both GTT and SBTT are significantly prolonged in IP CE exams compared to OP exams. In a multivariate regression model, we show that patient location (IP *vs* OP) and GTT are independent predictors of incomplete CE, suggesting factors other than GTT must be contributing to the lower CECR in inpatients. Here we demonstrate that increased SBTT is another important contributor for low CECR in addition to GTT. We further show that the CECR is lowest in the ICU setting.

CECR in patients with OGB has been investigated previously. In these studies, CECR are variable and lower than what we note in our study. In a prospective European study of only mild to moderate obscure overt GI bleeders, incomplete IP CEs were 21.6%, but in 75% of the incomplete exams there was some localization of the bleed site^[9]. However, this study excluded all severe bleeders and inpatients with other indications. In another study of 48 inpatient obscure overt GI bleeders from Europe, incomplete CE rates were 27%^[10]. In a recent Canadian study of 535 patients, overt GI bleed was found to be a major risk factor for incomplete CE ($P = 0.002$, OR = 2.7) and the overall incomplete CE rate was 29.5%^[11]. However, in this study, only 31 subjects were inpatients. Therefore, hospitalization status did not reach statistical significance despite a large trend ($P = 0.054$). In studies that analyzed CECR in patients with GIB, CECR in relation to patient location was not examined and direct comparisons to outpatients were not complete. Using subgroup analysis of our patients with GIB, we found a lower IP CECR compared to these prior studies (95% in OP *vs* 80% in IP). More interestingly, regardless of the GIB diagnosis, incomplete CE rate was also significantly lower in the OP setting compared to

the IP setting ($P = 0.001$).

The relationship between CECR and hospitalization was addressed more directly in two other previous European studies. When all indications were taken into account, incomplete CE rate was higher in hospitalized patients, 34%-35%^[7,8]. Our results in the United States confirm these findings in a larger dataset. GTT was elevated in the IP setting in both studies, similar to our findings. In the former studies, there were additional interventions to improve CE quality: per protocol, some patients received bowel preparation^[8], while others received both bowel preparation and prokinetic agents^[7]. Bowel preparation and the use of prokinetic agents are not routine in the United States. None of these prior studies specifically investigated the effect of IP location in CECR, and in one of these studies, patients underwent a 23 h hospitalization solely to perform the CE, which is not done in the United States. In addition lower IP CECR shown in these studies were attributed to decreased gastric motility; whereas we now show that the minimum SBTTs are also significantly prolonged in patients who had IP CE, suggesting that factors such as generalized dysmotility of gastrointestinal tract may be at play.

The overall CECR has been reported to be 81.1% and 83.5% in two recent meta-analyses^[12,13]. The first meta-analysis compared CECR in patients who were prepped with purgatives *vs* clear liquid diet prior to the CE and showed that there was no significant difference in CECR, although the purgative use resulted in better small bowel visualization quality and increased diagnostic yield^[13]. The second study reported an overall CECR of 83.5% in patients with OGIB, CD, and neoplastic lesions^[12]. The overall CECR in our study at 86% reflects a slightly higher value than reported in these two meta-analyses. Nevertheless, even if we were to assume that the CECR in our OP group was as low as 81%-83% (similar to the two meta-analyses), this would still be markedly numerically higher than our observed CECR of 68% in the IPs, and should not alter our conclusions. Our CECR may perhaps be reflective of the careful case selection at a tertiary urban medical center, in order to avoid retention. Alternative explanations could include a larger number of OPs compared to IPs in our study. Notably, the percentage of OPs and IPs were not delineated in the meta-analyses. While the latter studies included in the meta-analyses all come from the English literature, they could be conducted in various countries, where CE may not be routinely done as an outpatient. Additionally even within the United States, the capture area of each medical center may be different and may require some subjects to be IPs especially if the patient catchment area is wide and mostly rural. Our findings of lower CECR rates in the ICU setting might suggest that the severity of the acute illness may also play important roles in CECR. However, possible confounding factors such as medication use and certain comorbidities such as diabetes, neuropathy, and hypotension were not predic-

tive of incomplete CE in hospitalized patients. This suggests that multiple factors may have a combined effect in the outcomes observed in hospitalized patients. While our hospitalized patients were older than our outpatients and while our ICU patients were older than our GMF patients, age was not an independent factor that explained CECR differences, which have previously been demonstrated^[10,14].

Our study has several strengths including a larger IP sample size and a sub-group analysis on patient location and GIB. In our study, no confounding prokinetic agents or bowel preparations were used, and the hospitalization status was exclusively based on the severity of patients' clinical condition reflective of the current practice patterns in the United States. The major limitation of our study is its retrospective design; therefore, further prospective studies in inpatients are necessary to confirm our observations. Additionally, we took consecutive patients who had CE, and did not do a matched case-control design. This resulted in more subjects in our OP group compared to IP group - due to increasing use of CE in the OP setting. Therefore, it is possible that having less number of IPs may have resulted in potential unidentified confounders. As such, larger studies on IPs are needed to confirm our findings. Another potential limitation of our study is that, the readers of CE examinations were not blinded to the patient's clinical data. However, the readers were blinded to the hypotheses, making an outcome bias less likely to impact the study results. The lack of data regarding medication use, diabetes, and neuropathy in the outpatient group, lack of a generalized quality measure of the views obtained during CE exams, and the single center design are other limitations of our study.

Several interventions have been undertaken to improve CECR. The results of the studies which investigated the effect of bowel preparation on CECR were not consistent with each other^[15-22], but improved image quality has been reported. Previous studies also investigated the role of endoscopic placement of capsule and/or real-time viewing and showed that these approaches can improve CECR^[23-26]. Use of 12 h CEs could also be used to improve CECR^[27]. Future studies are needed to examine the effects of such interventions to improve CECR among inpatients.

In conclusion, inpatients have a lower than usual CECR, which is more pronounced if admitted to the ICU. While gastric retention is a reason in some patients for the lower CECR, there seems to be generalized dysmotility in inpatients with incomplete CE exams. Other factors embodied in the IP setting such as sedentary status and acuity of the illness could be partially contributing. A large prospective study is needed to further delineate the most important factors that contribute to incomplete exams in the inpatient setting and determine the impact of incomplete CE on patient outcomes.

COMMENTS

Background

Capsule endoscopy (CE) is being used widely to evaluate small bowel pathologies. It has applications in Crohn's disease, celiac disease, Peutz-Jeghers syndrome, familial adenomatous polyposis, hereditary polyposis syndromes, and particularly in the investigation of obscure gastrointestinal bleeding. However, the hospital setting may not be ideal in obtaining optimal results with CE as hospitalized patients tend to be more sedentary and have prolonged gastric and small bowel transit times.

Research frontiers

Two previously published studies indirectly examined the effect of patient location on CE completion rates (CECR), but both studies had limitations. Earlier studies also investigated the effect of bowel preparation, endoscopic placement of capsule and/or real-time viewing, and the use of 12 h CEs on CECR.

Innovations and breakthroughs

This is the first study to investigate the effect of patient location on CECR in United States. The authors demonstrated that both gastric transit time (GTT) and small bowel transit time (SBTT) are significantly prolonged in in-patient (IP) CE exams compared to out-patient (OP) exams. The authors also showed that patient location (IP vs OP) and GTT are independent predictors of incomplete CE. The authors further show that the CECR is lowest in the intensive care unit setting. While gastric retention is a reason in some patients for the lower CECR, there seems to be generalized dysmotility in IPs with incomplete CE exams. Other factors such as sedentary status and acuity of the illness could be partially contributing to lower CECR in hospitalized patients.

Applications

In addition to patient location other factors such as severity of illness and sedentary status may contribute to incomplete exams in hospitalized patients. CECR can be improved by doing CE studies as outpatient, placing the capsule endoscopically, using real-time viewing or 12 h CEs, and limiting the use of medications which decrease gastrointestinal transit time.

Terminology

CE is a procedure in which a small camera (capsule) swallowed to investigate the small bowel pathologies; CECR shows the percentage of CE exams that are completed; GTT is the time capsule spends in the stomach during the study; SBTT is the time capsule spends in the small bowel during the study.

Peer review

In this study, the authors investigated the effect of IP and OP status on SBTT and CECR. This is an interesting and well written paper.

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